6. Two particles, P and Q, lie at rest on a smooth horizontal surface.

The mass of P is $5m$ and the mass of Q is $3m$.

Particle P is projected towards Q with speed $3u$ and the particles collide.

The coefficient of restitution between P and Q is e, where $e > 0$

(a) Show that the speed of Q immediately after the collision is

$$\frac{15u}{8}(1 + e)$$

(5)

(b) Show that, after the collision, P and Q move in the same direction.

(3)

After the collision, Q collides with a smooth fixed vertical wall which is perpendicular to the direction of motion of Q.

The coefficient of restitution between Q and the wall is $\frac{1}{2}$

In the collision with the wall, Q receives an impulse of magnitude $\frac{45mu}{4}$

(c) Find the value of e.

(4)

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(Total for Question 6 is 12 marks)